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# SCIENCE

FRIDAY, FEBRUARY 21, 1913

THE STUDY OF MAN<sup>1</sup>

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IN that most amusing and instructive dialogue, entitled "Theætetus," the author Plato makes Socrates enter into a discussion with the youth by offering help as a skillful midwife to deliver him of a true and logical answer to the puzzling question: What is knowledge? When the youth replies,

According to my present notion, he who knows perceives what he knows, and therefore I should say that knowledge is perception,

Socrates proceeds—perhaps not altogether fairly—to identify his doctrine with the celebrated saying of Protagoras. This saying is about all we know of the positive teachings of him who was esteemed to be the founder of the Sophists. The proposition as expressed in the same Dialogue runs as follows:

Man is the measure of all things; of that which is, how it is; of that which is not, how it is not.

Even in the time of Plato the Sophists had translated this proposition into the doctrine: For every person, that is true and real which appears so to him. From this doctrine it was no long step to the conclusion, that there is possible for man only a subjective and relative, not an objective and universal truth.

From the time of Protagoras to the present, the view of the nature, authority, and limits, of perception by the senses, which his celebrated *dictum* embodies, has been the chief source both of popular and of scientific and philosophical scepticism; while the resulting doctrine of the relativity of all human knowledge, in its most

<sup>1</sup> Address of the vice-president and chairman of Section H—Anthropology and Psychology—Cleveland, 1913.

essential features, is widely dominant in scientific circles at the present time. I propose, therefore, to make it the point of starting for the consideration of two problems: First, What have modern psychology and anthropology to say about this theory of sense-perception and its resulting or allied theory of knowledge? and, second, What results from the answer to the first question as bearing upon a correct view of the relations in which the work of psychology and philosophy—the study of man—stands to the work of the other positive sciences?

But before we even propose in more definite form these two problems, let us consider in a word our right to group psychology and anthropology together under the common term, “the study of man.” That the two sciences have indeed some special relations as affiliated and mutually dependent and helpful branches of study, the very fact of this sectional meeting should seem to affirm. Indeed, so intimate are the relations between the two that there are points—and more than one of such points—where it is difficult to draw a line between them. If, for example, we speak of anthropology as inclusive of a wide range of sciences—physiology, ethnology, archeology, ethics, religion, “the rise of arts and science, and the history of civilization”—of which psychology is only one, we are met by the fact that psychology, too, has spread itself over the same territory, as affording feeding-ground for its insatiable appetite. Thus we have come to speak of physiological psychology, race psychology, the psychology of ethics, art and religion and of a so-called applied psychology, which undertakes to instruct teachers how to teach, doctors how to cure, lawyers how to examine witnesses, and even overwrought and neuropathic women how to

control their eccentric and pathological tendencies.

Nor can we claim that psychology, as at present studied, confines itself to the mental or subjective side of man, while anthropology deals rather with the objective and with man's place in nature. For anthropology falls short of its highest mission and most valuable opportunity, if it does not itself make a study of the spiritual evolution of the race. (I do not, of course, employ the words “spiritual evolution” with any cant or even definitely religious significance.) Both psychology and anthropology fail of using the only method of rendering themselves scientific, if they do not proceed according to the lines marked out by the conception of development. But without further remark upon this subject, we may perhaps agree upon the conclusion that the one, psychology, is, for scientific purposes, best defined as the natural history of the individual mind, or soul; and the other, anthropology, as the natural history of the race.

Even this attempt to distinguish the two, when reflected upon from the modern scientific point of view, shows all the more clearly how intimate is the relation between them. The dependence of anthropology upon psychology, as one of the sciences which it must take into the account, is pretty generally conceded. But what is not so universally acknowledged is equally true. This is the dependence of psychology upon anthropology. No individual man can fulfil the obligation of the ancient motto, “Know thyself,” without something approaching a scientific knowledge of the human species of which he is a member; of the acquired or inherent instincts, tendencies, inhibitions, naïve assumptions, emotional yearnings and strivings, which make up the greater portion of the influences controlling the so-called

nature, and natural history of the self. "Know thyself" means know thyself as a man, a member of the human race. And the natural history of the individual mind or soul, can not be described, much less explained, without interpreting it all in the light of what we have learned of the natural history of the race.

These remarks may suffice as introductory to an answer—confessedly fragmentary and full of assumptions which need proofs from sources lying outside our theme—to the two questions raised above. The first of these, you will remember, was this: What have modern psychology and anthropology to say about the view which identifies knowledge with sense-perception, and about its allied theory of knowledge?

If by perception by the senses we understand the mere fact that certain sensations form groups and sequences in consciousness, which have more or less of persistence and regularity, the banter of the wise Socrates as addressed to the youthful Thætetus is not inappropriate in our own day:

I say nothing against his doctrine, that what appears to each one to be, really is to each one, but I wonder that he did not begin his great work on Truth with a declaration that a pig or a dog-faced baboon or some other strange monster which has sensation, is the measure of all things; then, when we were reverencing him as a god, he might have condescended to inform us that he was no wiser than a tadpole and did not even aspire to be a man—would not this have produced an overpowering effect? For if truth is only sensation, and one man's discernment is as good as another's, and no man has any superior right to determine whether the opinion of any other is true or false, but each man, as we have several times repeated, is to himself the sole judge, and everything that he judges is true and right, why should Protagoras himself be preferred to the place of instruction, and deserve to be well paid, and we poor ignoramuses have to go to him, if each one is the measure of his own wisdom?

Even if we say, I do not mean the sensations of a tadpole, or even of a dog-faced

baboon, but the sensations of a man, we do not establish in perception by the senses alone a ground for science. The only way we can know what the baboon actually sees, or otherwise perceives through *his* senses, is by the use of *our* powers of perception as applied to the behavior of the baboon. Our claim to superiority over the baboon, even if we are descended from him in more or less direct line, is based upon the confidence that our perceptions, as forming a ground for a scientific knowledge of things, and perhaps for a theory of the universe, are more trustworthy and comprehensive than are his. The old-fashioned way of putting this truth was not so bad after all: Man may be an animal; indeed, he undoubtedly is an animal; but man is a *rational* animal.

Psychology, with its recent more subtle analyses, as made possible by the experimental method, has made it perfectly clear that sense-perception in the case of the human individual is an exceedingly complex development, involving all man's natural and acquired capacities and forms of functioning. Into every act of the senses which gives us intimations, or assured knowledge, of real existences and actual happenings, there enter many instinctive or acquired faiths, leaps to judgment or more slowly formed inferences, emotional factors expressive of doubt, or certainty, or negation, habits favoring or prejudiced against this or that conclusion, fleeting or more fixed associated images of memory or of fancy, and formal or regulating principles, the so-called categories or "innate ideas" of the earlier philosophy. But above all, if the process of sense-perception terminates in conviction of the reality of the object perceived, or the actuality of the event observed, then this object, or those things concerned in the event, are made the centers of forces that justify us in

giving them a place in a world outside of our own conscious selves. In other words: They are endowed with a will of their own, a will that wills not as we will. That all this is a species of the personifying of things, I have myself no manner of doubt.

But the knowledge of things as gained by the senses in the case of every individual, can not separate itself from the knowledge gained in the same way by the race of which the individual is a member. The motor reactions underlying the faiths and assumptions, the accumulated contributions of the faculties of memory and imagination, as all these are incorporated into the central nervous system, are matters of the development of the race. What even the average school-boy sees and hears, as well as thinks about and reads into his experience with the senses, is not precisely the same as that of the boy in ancient Egypt or Greece, or even the boy among the savage tribes of our own day. Are not the sense-perceptions of the believer in spiritualistic phenomena and in Christian science different from those of the sceptic and disbeliever, to-day, even when we place them in as nearly as possible identical relations to the object to be perceived? Here, then, is where anthropology becomes a valuable adjunct to any theory of sense-perception.

As to the theory of the relativity of all knowledge as stimulated by and embodied in the maxim that man is the measure of all things, its falsity or truthfulness depends entirely upon what is meant by the word "relativity." In the *Theætetus* Plato makes Protagoras—we do not know with what right—base his doctrine on the philosophy of Heraclitus. Now, no other philosopher of antiquity has been of late so re-habilitated in reputation and so clothed with honor as has the Ephesian Heraclitus. He was the founder of nat-

ural philosophy among the Greeks, the leader of the physicists of the fifth century B.C.

So powerfully impressed was he with the ceaseless change of things, the transitoriness of all the particular, that he sees in it the most universal law of the world, and can only regard the cosmos as being involved in continual change, and transposed into perpetually new shapes. All things are in constant flux; nothing has permanence.

If by the relativity of knowledge, as established by the psychological and anthropological study of man, we mean that no other knowledge is possible for human beings than that which comes into relation with human faculties for knowledge, there can be no objection to, or denial of, so obvious a truth. All man's knowledge of mankind and of the rest of the world is *human* knowledge and comes under the limitations and conditions of all human knowledge. Man's fields of knowledge have boundaries; and what he wins from these must be by patient and skillful using of the means of culture, his own senses and intellect applied to the data of his own experience.

If by the relativity of knowledge we mean also to assert that all knowing is an actual relating, an exercise of the function of relating activity, and that all things known are known as related to other things, we are only stating undoubted psychological facts. These facts are of fundamental importance in our interpretation of the true meaning of the saying, "Man is the measure of all things." Still further, if we mean that all advance in knowledge, on the part of the individual and of the race, is related to the past stages and achievements of knowing faculty, then, too, we are stating a truth on which psychology and anthropology may cordially unite. But when by the relativity of all knowledge it is meant to imply a complete distrust of

man's ability to discover and prove anything about the reality of the world in which he lives, or to apprehend with assurance of conviction what is now actually taking place within or without, or what has actually taken place in the past, we press our scepticism and its resulting agnosticism far beyond the limits warranted by a proper understanding of the Protagorean maxim. Man is indeed the measure of all things, *i. e.*, so far as things really exist for him or actually happen in the real world which environs his existence.

So, then, he who takes his attitude toward his own science, or toward the practical life, from that study of man in which psychology and anthropology may cheerfully concur, will undoubtedly hold to a certain theory of the relativity of all knowledge. This theory will lead him to say: There are a few things of which I have perfectly certain and absolutely sure knowledge. There are some more—perhaps, many more—of which I am reasonably sure; and the surer, the more I grow in knowledge. There are yet more of which I am in doubt, and about which I am holding my mind in suspense and open to the conviction which follows upon trustworthy and sufficient evidence. But the things I do not know are like a vast and limitless sea—to borrow an illustration from the philosophy of Kant—on the bosom of which lies my little island of knowledge and opinion. How far future explorers in all branches of science may sail that boundless ocean, or what other islands they may discover or treasures bring up from its depths, I am not going dogmatically to pronounce. That would be to assume more, in view of our present relations to the past and the future of science, than any one is justified in assuming. Besides as a student of man from the anthropological point

of view, I am taught to be cautiously agnostic in this regard.

But when any one says of himself, I know absolutely nothing about myself, or about things, or about the transactions between myself and things, or among things, which I am confident have a corresponding reality, he appears more modest with reference to his own powers than the doctrine of the relativity of knowledge requires that he should be. And when he goes on to say, You, too, know nothing, and can know nothing as to what is real and actual, he is not altogether polite, not to say flattering, toward a fellow aspirant for knowledge. But when he proceeds with the declaration: Neither I, nor you, nor anybody, really knows anything, or ever can know anything, about the real world and about the events assumed actually to occur in this world, his agnosticism has indeed taken a suicidal turn. For, surely such an agnostic knows that he does not know, and yet somehow exists in a world about which he and all others are in this state of perpetual and incurable ignorance; and this would seem to imply that I and others without number, in the most important respects like him, do also exist in an unknowable but undoubtedly actually existent world. It seems then that the complete agnostic is the man who is very sure that he can vindicate his agnosticism by appeal to some actual, objective standard of judgment which he and others possess in common. That is to say, while arguing from his doctrine that man is the measure of all things to the conclusion that no knowledge is possible, he involves the other very important conclusion or assumption that the world is full of actually existent rational beings, besides and outside of himself.

The importance of considerations like those just announced is greatly increased

when we apply them to the relations in which the study of man stands to that kind of knowledge which is embodied in the so-called positive sciences. The term science is properly applied to any grouping of knowledges to which has been given systematic form, and which has been based upon evidence that admits of being reviewed, estimated and, if possible, submitted to some kind of testing by comparison with other similar experiences. Thus science does not essentially differ from what we call ordinary knowledge; and when we extend the maxim which makes man the measure of all things to the positive sciences, we do not reduce their proof, their claims to acceptance as true pictures of reality, to the testimony solely of immediate sense-perception. No science consists solely or chiefly of data that can be seen, heard, handled, tasted or smelled. But all science, like all knowledge, whether we dignify it with the name of science, or not, is either envisaged or implied in data of concrete and individual experiences. And it is man's reasoning faculties which make explicit what is thus implied. For the method of all science is rationalistic, in the broad meaning of the term. In this work of rationalizing, the imagination, the faiths of reason, and even the emotional attitudes of the human mind toward truth and reality, play an important part. In every individual case, but more emphatically in the case of the race in general, every particular science is a development, an ever growing and never completed achievement of the human mind. And to this development, hypothesis, theory, deduction from known or assumed principles, are all as important and indispensable as is the correct and guarded use of the senses in perception.

In the day when our maxim was first enunciated, there was no positive science

of the physical, chemical or historical sort. There was much acute observation of phenomena, especially in the sphere of the moral, political and social life of man. The ancient Greek maxims for the regulation of the conduct of life have rarely or never been surpassed. The pragmatism of that day was in important respects, both more dignified and more satisfactory than the pragmatism of the present day. The Sophists were pragmatists of the most accomplished rank. But neither ancient nor modern pragmatism can ever give us science, or account for the existence, or the estimate of the values of science, properly so called. As a commentator on this very Dialogue of Plato has said:

The want of the Greek mind in the fourth century before Christ was not another theory of rest or motion, of being or atoms, but rather a philosophy which could free the mind from the power of abstractions and alternatives, and show how far rest and how far motion, how far the universal principle of being, and the multitudinous principle of atoms, entered into the composition of the world; which could distinguish between the true and false analogy, and allow the negative as well as the positive, a place in human thought.

It is only in comparatively recent times, however, that the different sciences of external nature and of man have devoted themselves intelligently and deliberately to the supply of that which was the want of the ancient Greek world of observation and of thought. The Greeks, for example, observed that a vacuum was created by the suction of a piston above the water in a pump. But the dictum, "Nature abhors a vacuum," was regarded as a sufficient explanation of the fact for more than two thousand years, before it was observed in jest by Galileo, that nature did not abhor a vacuum beyond ten meters. But Torricelli was the first really to explain the phenomenon by bringing it under the law of gravitation. Aristotle had observed—

and how many in our scientific age have observed for themselves?—that the sunlight, when passed through a small square hole, gives a round instead of a square image; but he explained the fact simply by saying that sunlight has a circular nature. It was centuries before astronomy established the true explanation in the fact that the sun itself is a circular body.

It was a combination of the principle sounded like a trumpet-call by Newton—"Abandon substantial forms and occult qualities and reduce natural phenomena to natural laws"—with the modification and improvement of the Baconian method of experimental induction which introduced the new era in the positive sciences of external nature. By following these principles man has made of himself a more accurate and faithful measure of all things; of that which is, how it is; and of that which is not, how it is not. But he still needs as much as ever the further study of himself, as an individual and as a race, in order so to supplement, modify, adapt and otherwise improve the principle, that all the various classes of that accepted and certified knowledge which he calls by the name of science, may benefit by this study.

I come, therefore, at once to what is the main purpose of this paper. It was announced in the second of the questions proposed at the beginning. This question concerns the more fundamental of those relations in which the study of man stands to all the other positive sciences. Generalizing these relations, I will say that the study of man as the measure of all things is entitled to set forth and expound (1) the method of science; (2) the limitations of science; (3) the ideals of science. And what it is entitled to do for science in general, it may properly suggest as desirable

and true for each one of the particular sciences.

Intelligently comprehended and faithfully interpreted, the study of man, the measurer, is the only way to find out how his measuring-rod ought to be applied to the different objects which come before him in the different classes of his varied experience. Every positive science, and we might almost say every subdivision of such science, has its special, most satisfactory mode of procedure in the search for truth. That this is of necessity so was known to Aristotle as distinctly as it is known to any modern man of science. Indeed, the principle was never better stated than it was by him in the first book of the "*Nichomachean Ethics*." There the great Greek thinker holds that the matter of a science, *i. e.*, the facts or conceptions with which it deals, must determine its method or form, according as they admit of being stated with more or less "precision" (*Ἀκρίβεια*). But the Greek word which I have imperfectly translated by the English word "precision" means in Aristotle's use of it a combination of mathematical exactness, metaphysical subtlety, minuteness of detail and definiteness of assertion. And as applied to the form of science, or study of one aspect of man, namely, the ethical, which he is proposing to consider, he distinctly states that mathematical exactness is quite unsuited to ethics; that we must not expect too much subtlety, and that too much detail is to be avoided. In this respect his view is more liberal and more true to the nature, limitations and ideals of human science than is that of Sir Isaac Newton when he insists that all "natural phenomena," including the biological, shall be reduced to "mathematical laws." For every step in the evolution of science, as subjected to the conclusions derived from a study of man,



shows that a knowledge of qualities and relations of quality, many of which do not admit of a reduction to mathematical laws, is an indispensable part of all the sciences which deal with natural phenomena.

Every particular science, and, if you please, every form of experiment in each one of them all, should be allowed to determine its own method in the details of its observations, testing the alleged facts, and obvious conclusions from the facts. There is really no reason for assuming a sort of holy mystery about scientific method in general, or about any particular scientific method. Method is any means of arriving at the truth of reality. The greater truths of science, as well as of religion, have always been revealed to gifted—and for my part I am willing to say, inspired—minds, as flashes of intuition, fortunate guesses, hypotheses which as yet awaited verification but shone with that light which announces the clearer vision of the approaching day. I have always had a sneaking sympathy with that schoolboy who, when he came home from school snivelling because he could not do the sums in mental arithmetic set by his teacher, and his mother reminded him that, of course, he had been taught at home the correct answer to them all, replied: “Yes, of course, I know what the answer is, but I can’t get the method.”

While, then, we admit the right and repose the obligation to any special form of technique, as a matter for the particular sciences to decide for themselves, we still insist that the nature of the human mind and of its development in the individual and in the race is the source of all the experience which determines the successes and the failures in the use of every particular method in each of the particular sciences.

Still more definite but brief statements

with regard to the doctrine of method which the relativity of all knowledge makes imperative would seem in place at this point. If man is to take even his preliminary measurement of things, of that which is, how it is, and of that which is not, how it is not, by sense-perception, he must use trained senses with inexhaustible patience, and with freedom from prejudice and professional pride and ambition. Some years ago the retiring president of the Association of American Naturalists, in his address at the annual banquet, related this recent experience of his own. He had written to a considerable number of the leading biologists in the country, asking that they should give him just the bare facts as they had observed them, and with no admixture of their own views in explanation, upon a certain matter which he was engaged in investigating. “Even so,” said this scientific observer, “I could not get the simple unsophisticated facts reported.” How many biologists and physiologists in the world at the present time, whatever confidence they may have in the ability and sincerity as an observer of Dr. Bastian, are sure he is giving them just an unprejudiced statement of the facts in proof of his theory of spontaneous generation?

The psychological study of sense-perception, as strengthened by the anthropological study of man’s progress in knowledge, shows with undoubted clearness, not only that the details of every man’s sense-perceptions are his very own and quite unique, but also that the influence of habit, expectation and interest, contributes largely to what the senses are bound to perceive. But the true doctrine of scientific method which follows from the study of man as a measurer of things by his senses, logically followed, does not land us in an absolute distrust of the senses, in a gulf of scepti-

cism and agnosticism with regard to all human knowledge. The rather should this study serve as a reminder, how uncertain and slow is the laying of solid foundations for the building of the temple of science; but also, how solid those foundations, when well laid, actually are; and how noble the temple which man is erecting toward the skies, on these same foundations.

Among a certain class of psychologists and philosophers—I am ashamed to confess it—there has been much deprecating and even sneering, directed toward the stern control of the logical faculties in the discovery and proof of the nature of reality. “The will to believe,” or the leap of emotion to conclusions affecting the nature of reality, has been attractively offered, and far too freely accepted, as a substitute in science as well as in religion, for the use of reason under the control of reason’s lawful working. But the study of man utters a loud warning against all this. Even a truly scientific mind may express itself and its findings in an alluring rhetorical style. But such a style can never be safely trusted as evidence for, however effective it may prove in exposition of, the truths of either common life or science and philosophy. Logic may be fervid, but it must still remain logic, if it is to be offered in proof of truth. On the one hand, it is true that a purely logical or dialectical construction of scientific theory, after the Platonic or the Hegelian method, when it cuts itself from the bonds which tie it down to concrete facts of more or less nearly universal experience, is not man’s way to measure most faithfully the truth of things. But, on the other hand, it is equally the fact that only by the use of the intellect, the logical or so-called dialectical faculty, can the truth be explicated and interpreted as it lies hidden in the facts. The history of scientific progress shows beyond all ques-

tion, that it is not great collectors of facts, but great thinkers reasoning concerning the meaning of the facts, who have most contributed to this progress.

An additional consideration of no small importance which is made quite clear by the natural history of the individual mind, as well as by the natural history of the race, is this: Knowledge is not only a matter of development, of progressive achievement, in the individual and in the race; it is also a matter of degrees. Any body of knowledge, no matter how strictly it may be entitled to the term science, will necessarily consist of propositions that are made with quite different degrees of assurance. This truth should always be frankly acknowledged in the methodical procedure of every science. Every positive science will, of course, aim to have its different conceptions, so-called laws, and fundamental principles hang well together. It will also attempt to fortify itself by coming into relations of mutual support with the other most nearly allied sciences. It will, above all, test its own conclusions by the amount of agreement which its own best students and trained experts have been able to reach as exponents of the best intellects of the race, in their prolonged and unprejudiced application to the problem of interpreting the experience of the race. But every science will also remember that the very method of science, as inexorably fixed by the nature of man’s intellectual processes, makes it necessary to discriminate different degrees of knowledge, with shifting degrees of certainty and changing claims to importance, as the knowledge of the race advances in clearness and comprehension.

In this connection it is worth while simply to call attention to the fact that the mental attitudes of scepticism, criticism and agnosticism are indispensable and val-

uable factors in all scientific method. Every investigator who attempts to employ the proper method in measuring the things of his special science, is bound to be, always a critic, often a sceptic, oftener still an agnostic. But every investigator is also yet more imperatively bound to be critical, sceptical, agnostic, in right directions; and toward the different conventional opinions, and accepted conceptions and laws constituting the body of that science, in accordance with the varying degrees of evidence and proof.

One thing more on this point. The study of man in any broad and sympathetic way shows us unmistakably that an essential element in all scientific method is a certain indestructible confidence of reason in its own ability, by repeated trials and successive approaches, to reach the truth of things. Man as the measurer of all things is somewhat like those conceited tailors to whom we are sometimes compelled to resort in our efforts to get a perfectly fitting suit of clothes. He is always trying on the coat and altering it, until he has reached the limit of the cloth he has sold us; and then we must be contented with his assurance that it fits us perfectly, while in our secret thought we are troubled with the suspicion that it fits us only fairly well. At any rate, for the present the process of fitting can no further go. At the annual meeting of the British Association in 1904, there were two things, according to the reports in the newspapers, on which those in attendance were all agreed. One of these was that they had never before had quite so fine a time socially; the other was, that in none of the branches of the association was there any one where all the members were in agreement upon any one thing.

Cast a glance over the history of science in general, or over the history of any one

of the particular sciences. Those who scorn philosophy under the pseudonym metaphysics are fond of making merry over the persistent and universal lack of agreement on any one point, of the philosophers from the beginning of reflective thinking until the present time. But the simple fact of history is that the more fundamental tenets of philosophy as held by the different schools have been far less subject to change than have the important conceptions and so-called laws of the particular sciences. What enormous changes have taken place in all these sciences since the improved methods of studying their data have gained general acceptance and been put into general practise! Each one of these sciences is accustomed to boast: In the last half century or less we have made all things new. And with regard to the future of science the words of Scripture are scarcely too strong to describe its apocalyptic vision:

And I saw a new heaven and a new earth; for the first heaven and the first earth are passed away.

All man's voyage on the sea of knowledge, for the discovery, mapping out and exploiting of the new domains of science, is strewn with the wrecks of voyagers in the distant or near past. Never before were so many vagaries and visionary schemes and unproved hypotheses demanding attention and credence. But never before was the fleet of voyagers so numerous, so competent, so sound, so sure of its future, as at the present time. How can such things be? How can the measurer always be making such misfits, spoiling so much cloth, and annoying so much his patient, trustful customers, and yet retain his own immeasurable self-conceit? There are two reasons which establish the sufficient answer to this question. One of these is the indestructible faith of human reason

in itself. It hesitates, it stumbles and makes mistakes and either confesses and corrects or stubbornly adheres to them; but it never despairs or is utterly confounded. The other reason is this: History shows that this confidence is more and more, in fact, justifying itself. All progress in knowledge depends ultimately for its justification on this self-confidence of human reason; but all actual progress in knowledge is a further justification, in fact, of the confidence on which it depends. Man has faith in himself to know; in exercise of this faith, he actually attains higher and higher degrees of knowledge. While, then, constant criticism, frequent scepticism, much rather persistent agnosticism, are attitudes of the human mind toward reality, which should always characterize the method of science; scornful criticism, despairing scepticism, universal agnosticism, are essentially antagonistic to the true spirit and hopeful method of science. And those who cherish such views of the relativity of all knowledge are dissenters from the one form of faith which underlies all particular forms of faith, intellectual, social, religious. An ever present and essential feature of man's rational being is rational faith, or reason's own confidence in itself as the organon of truth.

While, then, each particular science has its own special methods of procedure in the discovery and testing of its own conceptions and laws, there is a certain universal method; or, the rather, there are certain general considerations touching a universal method, which all must observe. Three rules of method, confirmed by the psychological and anthropological study of man, provide for the patient, unprejudiced use of perception, by way of self-consciousness and through the sense, of the facts; the consistent and controlled use of the logical faculties in the interpretation and explanation of these facts; and a justi-

fiable faith in reason as opposed to the positions of a despairing agnosticism. It is not the ancient Sophistical or the modern pragmatic interpretation of the Protagorean maxim, Man is measure of all things; of that which is, how it is; and of that which is not, how it is not, that can guide us into the safe and fruitful method to be pursued by the positive sciences. But, then, it is a comfort to know that even those devotees of these sciences who confess a faith in this interpretation, never take their faith with any large amount of practical seriousness.

A second important way in which the study of man is related to all the sciences concerns the limitations of all science. We are all familiar with the many mistaken predictions as to the limitations of particular sciences which have been made in a merely empirical way. In the "*Memorabilia*" Xenophon makes Socrates remark upon the impiety of men in trying to describe how the gods made the world of things; since all knowledge of this sort is forever beyond the limits of human faculty. In the "*Timæus*," however, Plato makes Socrates indulge in the wildest speculations, in dreams exceeding those of the poet and resembling those of the madhouse, as to how this same world may have been made. No sane student of science now believes that the actual limitations of science are of either sort—either that asserted in the "*Memorabilia*" or that notably transcended in the "*Timæus*." It is the business of science—a matter of obligation rather than a mark of impiety—to know how the natural universe was made and is being made. But when the mind assumes to dream its way into this kind of knowledge, it grossly violates the laws which inexorably fix for all time its impassable limitations. Within the fields of science itself there are constantly occurring

dogmatic statements as to what is intrinsically possible or forever impossible, for the endeavors of human knowledge. Have we not been told that the distances of the fixed stars could never be measured; that the achromatism of lenses could not be carried beyond a certain point, which has already been considerably surpassed; that steamships could never cross the ocean and airships never sail the air, in safety; that synthetic chemistry in the laboratory could never simulate the products of animal and vegetable organisms; that the speed of the nerve current could never be measured, etc., etc.

But what does all this purely empirical way of fixing the limitations of science amount to in the respect of justifying our attempts to regulate the hopeless waste of man's endeavors to know the forever unknowable? Even to-day we may be just as ignorantly—with an ignorance even made more exasperating by the fact that it is so often the outgrowth of our conceit of knowledge—denying the alleged facts of telepathy as was Newton when he refused to explain gravitation as *actio distans*. But whether this or that particular prediction come true or not, this is not the point. The point is this: that by the study of man we are able to fix certain limitations to all science which are inherent in the very nature of man himself and in his relations to that larger nature of which he is a part. It is to the consideration of this sort of limitations that we now devote a moment's attention.

That the senses, from the nature of the psychophysical organism which they serve, are limited in capacity, is a matter of course. Their anatomical structure and their forms of functioning, physiologically considered, require that the range and accuracy of their observation should be confined within certain limits, both of space

and of time. In the eye, the size of the rods and cones; in the ear, the physical construction of the bony and muscular parts of the cochlea; in the skin, the frequency and arrangement of the temperature spots and the pressure spots—all these special limitations of the organism are limits to the measuring power of human sense-perception. Let these physical limitations be changed, either in the direction of improvement or of depreciation, and there would still be similar limitations inherent in the organic structure of the race, and varying with different individual members of the race. In all the various realms of sense-perception, there will always be that which lies beyond, and which can only be conjectured, or at best reasonably inferred, but which can never become immediately perceived by human senses. Surrounding the expanding island of the visible world will be the boundless sea of the invisible; of that which can be touched and handled, the many things that no skin is sensitive enough to feel and that no hand can grasp.

These limitations of the senses set their limitations to the pictorial imagination, or imaging faculty, as distinguished from what logicians have been accustomed to call "pure thought." How things would look, the like of which no eye has ever seen; how things would sound, the like of which no ear has ever heard, will remain questions to which the experience of measuring all things with the senses can give no answer.

But there are other irremovable limitations to human knowledge which are even more important, although more difficult to make obvious. These are limitations inherent in the very constitution of the intellectual powers. The intelligence of man has its own way of working, its laws of behavior, its inescapable modes of operation, to whatever subject it may be applied.

The attempt has indeed been made to account for forms, laws, innate ideas—call them what you will—as the results of a process of evolution. In my judgment, such an attempt must always remain a complete failure. The so-called primitive man in the long gone-by ages reasoned in substantially the same way as that in which the German professor of physics or the American financier or politician reasons to-day. Nor does it appear that the savage peoples of the present time have essentially different minds from our own, or are intrinsically inferior in the acuteness, speed and accuracy with which they reason. Their limitations, as compared with ours, consist chiefly, if not wholly, in the extent of the accumulations of experience with a wider world of things and of men, which lie behind them in history and which constitute their present environment. But we as well as they, and no less truly than they, when we measure things by minding them, know them only according to the formal limitations of our own minds. These limitations concern the comprehensiveness, the certainty, the range, both toward the large and toward the small, the simple and the complicated. The infinite and the infinitesimal may be symbolized and carried as symbols through complex mathematical calculations; but they can never be envisaged by the senses or comprehended by the intellect.

This sort of irremovable limitations surround all the growth and all the achievements of the particular sciences, and might be set forth at any length in the discussion of the categories of science. But such a discussion would be too technical for our present purpose and would take us much too far afield.

Some illustration of what is meant will serve our present purpose. The history of the growth of science for two thousand

years shows many curious attempts to dispense with the obligations put upon the human intellect by the so-called categories, or fundamental and irreducible forms of conceiving of reality, that seem to flow from the very nature of the intellect itself. This effort among the students of physics is particularly insistent and even violent at the present time. But it is just as certainly doomed to failure now as it has ever been. For example, we are treated to a science of physics which would do away with the realistic conceptions of substance and cause, and would substitute for them the more impressionistic and phenomenal conceptions of motion and change. For do we not, with our senses, which are the measure of all things, of that which is, how it is, and of that which is not, how it is not, become actually aware of motions and of changes? But who ever saw, heard, felt, smelled or tasted, of a substance or a cause, in the metaphysical meaning of these words? Go to, then! Let us banish metaphysics and confine our scientific measurements to what the senses can actually perceive. But the conception of motion without this adjunct or underlying conception of something real that actually moves, or the conception of a change that is not caused, or compelled by, or otherwise to be attributed to, some actually existent agent, is a ghostly and intolerable conception. And the world in which relations of motion are supposed to be the sole topic for scientific investigation, is a ghostly and not a real world. But we may always observe by reading between the lines that the “scientist,” because he is also a man, and is under the limitations of human intellect, has allowed to sneak in at the back door the very conceptions which he has more or less impolitely dismissed from the front. He must have a “that-which” as substance for his observed motions and as a point of

attachment for his observed changes. For reality is not made up of modern scientific, any more than of ancient philosophical, abstractions. It is, the rather, a theater in which real things are always actually doing something to one another, and in which each one is having something done to itself. There is nothing which the student of physical science more needs to learn from the study of man than that he himself is of necessity a metaphysician, and can only choose between some wisely and well thought-out metaphysical views, and a naïve, crude and misleading metaphysics of his own uninstructed self.

But the final question respecting the limitations of science as they are expounded by the study of man is this: Are they limitations of ignorance or limitations of knowledge? In other words, because there are inherent and inescapable limitations to the human intellect, are we to conclude that man as the measure of all things can really know nothing, just that it is and how it is, or are we to conclude that his knowledge, although never complete and all-comprehensive, is nevertheless knowledge indeed? And by "knowledge indeed" we mean that the real world and its actual happenings are in fact, progressively being more largely and accurately known by the combined achievements of the race? The proof of this faith, if there be proof, belongs to a department of philosophy which we are accustomed to call epistemology or theory of knowledge. In this connection I am only expressing my faith when I say that it is the same as the faith of the race.

Finally, the study of man is entitled to say what the true and worthy ideals of science are. For the scientific mind, the tenets of modern pragmatism with respect to the nature and meaning of truth can never be permanently satisfying. For

science, knowledge has more than a merely practical value, and its tests are something more, and different from the mere success of its practical working. For science, knowledge has an ideal value. We are wont to express this by speaking of the worth of science for science's own sake. But the better, because the truer way to express this ideal is to say that knowledge as knowledge, and science as science, has value for man's sake. And this is because man's mind craves for, feeds upon, finds its satisfaction, uplift and refinement in, the growth of knowledge. To the human mind, or spirit, when it awakens to a realization of its call and its obligation to realize its own higher forms of privilege, and to improve its best opportunity, science affords a satisfaction that has a value of its own.

This is not to say that science has not contributed, and is not bound and glad to contribute, to the so-called practical and utilitarian in the life of man. Chemistry is not pursued with eagerness and satisfaction, and almost religious awe before the mystery of material existence, as a purely mercantile affair. But modern chemistry is transforming almost every branch of modern industry to the great practical benefit of mankind. Modern physics is not cultivated as the servant of the U. S. Steel Corporation, or the General Electric, or the Mercantile Marine monopolies. But the founders and promoters of these corporations owe every dollar of their legitimate earnings or of their graft, and the public owe all the material benefits which have fallen to them from these corporations, chiefly to modern physics.

The satisfaction of man's rational aspiration for knowledge is not, however, the only ideal which the study of man recommends for confidence and intelligent pursuit, to the other sciences. Every science,

no matter how seemingly remote from current human interests, and from man's daily life, may reasonably cherish a spirit of devotion to the social ideal. In educational circles there is just now great debate over the comparative values of the studies called abstract and those called practical, as constituting a preparation for the duties and responsibilities of "real" life. While admitting the reasonableness of this distinction and the value of certain proposals to alter the disposal of time and attention to be allotted by the average man to the two, we wish now to insist upon the thought that no form of science need be pursued, or ought to be pursued, without regard to the relation in which its pursuit stands to the social ideal. The pursuit of knowledge for knowledge's sake is itself a moral benefit to the normal man. And you can never bring about the social ideal, or advance far toward it, without discipline in the pursuit of knowledge. One of the ideals which science prizes and promotes is the ideal of a society, and finally of a race, which is so disciplined in knowledge that it may know how to be wise and upright in conduct. For, although such discipline is not the whole of what contributes to the moral and religious uplift of the race, without such discipline moral and religious progress is impossible for the race.

Hovering over all like a vast but glorious cloud that is being illumined, through the rising mists, by the rising sun, is the ideal to which the combined work of all the sciences is being directed for its better discovery and interpretation, the ideal of a universal order which has at its core, and through all its historical evolution, the unity due to rational mind. This conception in its modern outlines has been won by the toil of thousands of observers and thinkers, and slowly expanded and guaranteed, as it were, by the experience of the

race. It is confessedly incomplete; perhaps it will always remain incomplete. For reality itself is no closed and once-for-all finished affair. But that the world is a realization in time and space of some such ideal as science has built up—an ideal unity of order, beauty and meaning—this is the growing conviction upon which the particular sciences, from their different points of view, and by their different methods, have been converging.

I must ask your further indulgence while I close this paper—already prolonged to an excessive length—in a fashion somewhat sermonesque, *i. e.*, with two practical and hortatory applications.

This view of man as the measure of all things calls upon those who engage in the scientific study of man, whether from the psychological or the anthropological point of view, for comprehensiveness and catholicity. All the other sciences are becoming more definitely tributary to the study of man. His marvellously complex and delicate organism traces its history through indefinite ages of evolution to an unknown and probably undiscoverable past. The description of this organism requires the combined results of the physico-chemical and biological sciences. What we call his mental and social nature and development enlists the efforts of the whole round of the psychological and historical sciences. But we are not ready for a complete and just estimate of the capacity of man as the measurer of all things until we have studied him as a speaking animal, a being with moral, artistic and religious ideals; and with a certain limited though genuine capacity for a self-controlled development in pursuit of these ideals. In a word, both psychology and anthropology are under the obligation to extend their studies, in the interests of comprehensiveness and catholicity, so as the better to understand and



master the spiritual nature and the spiritual development of the individual and of the race.

And, finally, our view of man as the measure of all things is an exhortation to an increase of sympathy and of sympathetic cooperation among all the different sciences. Of the particular sciences and their subordinate branches and subdivisions, there is an ever-increasing number. But their aim is one aim; and in the pursuit of this aim they should be as brethren dwelling together in a spirit of friendly criticism and also of friendly unity. The aim of all human science is the better to understand man by himself, and the greater nature which environs him; and the better to adjust himself to this greater nature, in the pursuit of his economic, social, artistic and religious ideals.

I venture to close with the words which Plato puts into the mouth of Socrates as he closes his conversation with Theætetus:

But if, Theætetus, you have or wish to have any more embryo thoughts, they will be all the better for the present investigation; and if you have none, you will be soberer and humbler and gentler to other men, not fancying that you know what you do not know. These are the limits of my art; I can no further go; nor do I know aught of the things which great and famous men know or have known in this or former ages. The office of a midwife I, like my mother, have received from God; she delivered women, and I deliver men; but they must be young and noble and fair.

GEORGE TRUMBULL LADD

PLEISTOCENE GEOLOGY OF NEW YORK  
STATE. II

LAKES

*Glacial Lakes: Occurrence.*—The term "glacial" is used by the writer to include only lakes which existed by virtue of a glacier ice barrier. The lakes and lakelets now existing and called "glacial" by some authors should be discriminated mostly as morainal or drift-barrier lakes.

The conditions necessary for a glacial lake are a valley or depression sloping toward and blocked by the ice front. These conditions were fulfilled in New York on so large a scale, in area and time, that the state, it is confidently believed, held the largest number and the most remarkable succession, with varied outflow, of glacial lakes of any district in the world. The reason for this superiority is found in the peculiar topography of the western part of the state. In the great Ontario-Erie basin we have a broad depression with its lowest passes on the east and west, and with a deeply trenched southern slope where lie the parallel valleys of the Finger lakes.

The only glacial lakes of which clear evidence is preserved are those which lay against the receding front of the latest ice sheet. But it should be clearly understood that every ice sheet which transgressed the state blocked the waters both during its advance and its recession.

We do not know what portions of the Valley-Heads moraine, which now constitutes the divide and forms the south limits of the basin, were left there by Prewisconsin ice sheets, but we may be quite sure that the lakes during the advance of even the last glacier were somewhat different in dimensions and relations from those of the ice recession, which are the subject of our field study. We may also be sure that the earliest ice invasion found the series of parallel valleys with fairly mature and graded forms, and open clear through to their heads, and the larger ones heading in Pennsylvania. Those earliest ice-impounded lakes must have been longer and deeper in the valleys than the lakes of later episodes, when the valleys had become more or less occupied by glacial and lake deposits. The lacustrine conditions of the episodes antedating the Laurentian ice re-